STRUCTURE AND DEVELOPMENT OF BUDS IN THE LEAF OF BRYOPHYLLUM CALYCINUM, SALISB.

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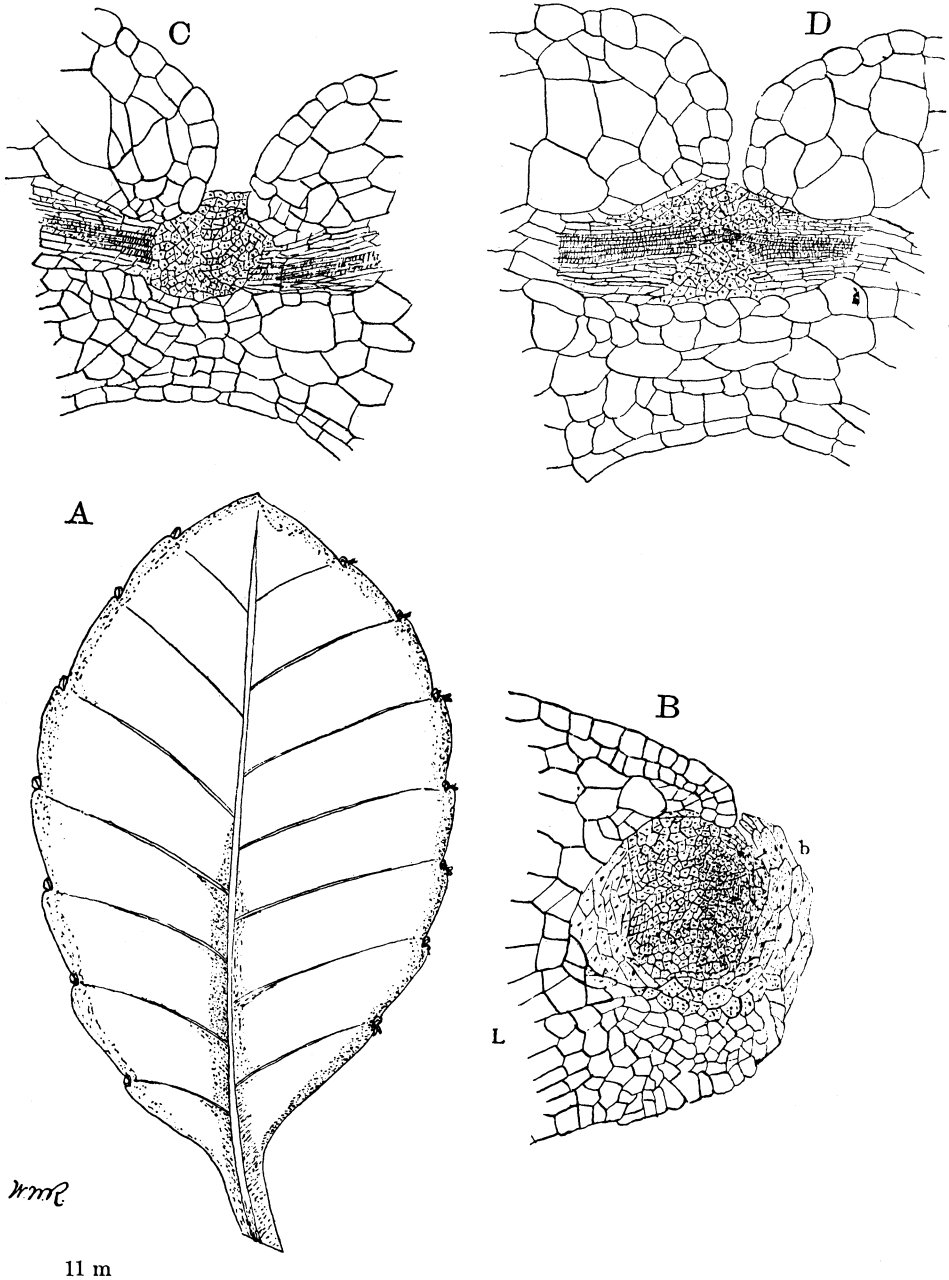
It is a well-known fact that the leaves of certain plants, if placed under suitable conditions, will send out root and stem and eventually form a new plant. Most plants that reproduce themselves by leaf-cuttings do so only after the petiole or blade is mutilated. *Bryophyllum calycinum* is a noteworthy exception to this case. If a leaf of this plant is removed from the stem and placed upon a moist substratum for a week a new plant will start from the dentations of the leaf and in two weeks may be a plant of considerable size.

By a careful examination of the epidermis of the leaf, it will be seen that in the most protected part—*i. e.*, in the deepest part of the indentation of the margin—the tissue differs slightly in appearance from the other epidermal surfaces. There is no protuberance, however. A section taken through this part of the leaf (Plate I, B) shows that the tissue at this point is very much modified. This is the bud. It is spherical and is clearly defined from the surrounding tissue of the leaf, and is only slightly exposed on the side toward the margin of the leaf. It is in contact with a fibro-vascular bundle, some of the vessels of which seem continuous with its meristematic cells. The tissue of which it is made up is meristematic and is not much differentiated. Its cells are filled with protoplasm. They contrast with the surrounding cells in size, thickness of cell-wall, contents, and arrangement. They are very compact, and are so organized as to form a distinct body. There are regions in the bud where the tissue is more active than in other parts. This is shown by the deeper stain taken in these parts, as well as by the greater number of nuclei in a given space. The upper part of the bud begins the growth destined to produce the stem of the young plant, and below is produced the first root. The similarity here to the growing points in the seed will be immediately seen, the upper part corresponding to the plumule and the lower to

PLATE I.

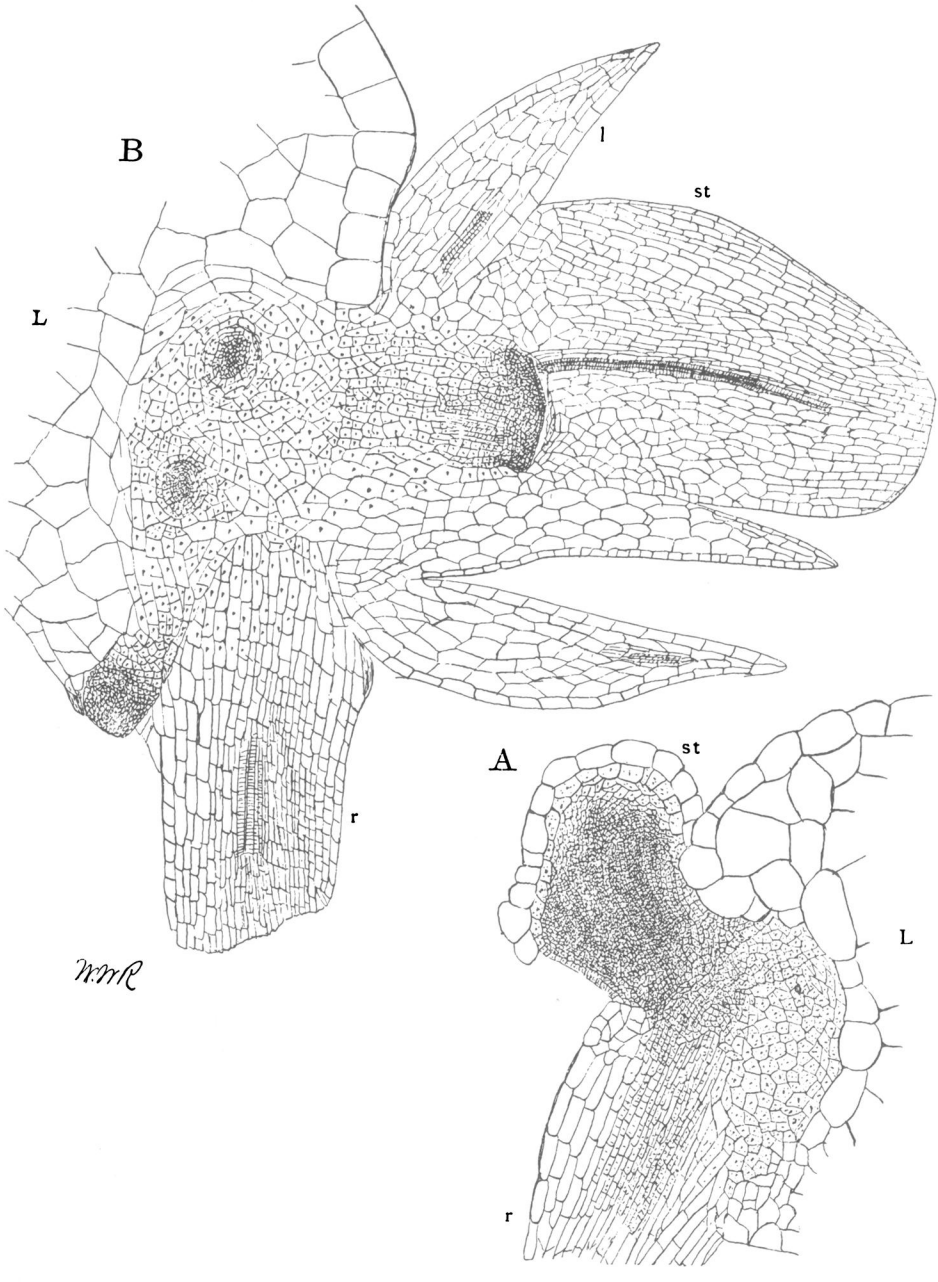


the lower tip of the hypocotyl. No differentiation of parts occurs in the bud before it begins growth. It is covered, however, with a tolerably well marked epidermis upon the upper and outer sides. (The epidermal layer is not shown as well in the drawing as it appears in the actual specimen.)

C and D, Plate I, are drawings from serial sections taken through the bud in a plane tangential to the margin of the leaf, and in a plane at right angles to the surface of the leaf. D is slightly deeper than C. The aspect is the same as though one were looking directly at the margin of the leaf. It may be seen here, as well as in the section taken in the other direction, that the lower portion of the leaf comes out fartherest. The point of the bud exposed is that part of its surface facing outward and upward. A fibro-vascular bundle passes directly behind the bud. As the bud grows there does not seem to be a direct bundle leading from the bundle of the leaf to the fibro-vascular system of the new plant. The vascular bundles of the young plant take their rise very near the original and seem to me to be derivatives of its tissue. Dr. Goodale, in "Physiological Botany," p. 162, says: "It is interesting to observe that in all these cases (*Bryophyllum et al.*) the bud forms without the intervention of the fibro-vascular bundles of the leaf. The newly formed axis has fibro-vascular bundles, which may anastomose with those preëxistent in the leaf, but usually they are entirely distinct."

When placed under suitable conditions of heat and moisture the buds promptly begin to grow. The first evidences of germination are seen in two or three days after the leaf has been "planted." There is a slight bulging of the tissue on the lower side of the leaf and slightly back from the angle in which the bud lies. It is not strictly conical in shape, but is flattened in the plane parallel to the margin of the leaf. Looking from the lower side of the leaf into the angle a slight swelling of the tissues can be distinguished in the center of the indentation. In an other day the germination will be complete. Through the bulging tissue on the lower surface will have pushed a smooth shining rootlet, perhaps two millimeters long. In general appearance it is like the root as it starts from the lower tip of the hypocotyl of a germinating seed. It points downward and slightly outward or toward the margin of the leaf. It pushes its way directly through the epidermal tissue, leaving only slight evidences of the displacement of cells, that must have taken place. There is a distinct line marking off the root from the epidermis of the leaf, when looked at from the outside, however, and

PLATE II.



the epidermis slopes from the root as it did before the root appeared. There are no root-hairs at this stage.

From below, the bud in the axil is seen to have increased in size and may also now be seen from the upper surface of the leaf. This is destined to become the stem of the young plant. The growth of the stem is much slower than that of the root. Leaves soon begin to appear, however, at first only distinguishable as slight projections on the bud. The first root has scarcely more than secured a hold in the soil before there appear others, all springing from the bud—some through the lower epidermis, others through the tissue in the angle at the sides of the stem, and yet others through the upper epidermis back of the stem. Cell division cannot be traced to any one or two cells, but is rather confined, it seems to me, to definite regions in the bud. The whole mass of tissue is organized in the leaf as it develops. When the leaf matures the bud is a globular mass made up of small parenchyma cells and surrounded by the large parenchyma cells of the leaf.

Explanation of Plates I and II.

PLATE I.

A—Leaf of *Bryophyllum calycinum*, showing buds in indentations of margin.

B—Section of bud taken in plane at right angles to the surface of the leaf, and also at right angles to its margin. (× 120.)

C and D—Sections of bud taken in plane parallel to margin of the leaf. (× 120.)

PLATE II.

A—Bud just beginning to "germinate."

st—Rudimentary stem.

r—root.

L—Parent leaf. (× 150.)

B—Bud, still older. (× 150.)